THE EXPLOSIVES ENGINEER

MAY-JUNE · 1959 VOL. 37 · NUMBER 3

NATIONAL SAFETY COMPETITION OF 1958

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HERCULES

THE EXPLOSIVES ENGINEER

Forerunner of Progress in Mining, Quarrying, Construction

The winners of the National Safety Competition of 1958 are announced in the article beginning on page 71. This competition, conducted by the U. S. Bureau of Mines, determines the winners of the coveted Sentinels of Safety trophies provided by THE EXPLOSIVES ENGINEER. The competition originated in 1925 from a conference called by the Honorable Herbert Hoover, then Secretary of Commerce, seeking a remedy for the mounting injuries and deaths in United States mines and quarries. The editor and staff of THE EXPLOSIVES ENGINEER, who were among those invited to the conference, suggested a nation-wide competition to be conducted by the Bureau of Mines, with the trophies in the several classifications to be provided by the magazine.

The article by John C. Machisak, Chief, Branch of Accident Analysis, Division of Safety, Bureau of Mines, U. S. Department of the Interior, reports the number of participants in the 1958 competition at a new high, while the injury rates held near their lows for the 34-year period.

° ° °

The Colorado River Basin project of the U. S. Bureau of Reclamation is an undertaking so vast in scope that it staggers the imagination. Covering an area of 110,000 square miles, an area larger than the states of New York, Pennsylvania, and New Jersey combined, the project is designed to store and distribute water to make this arid region productive farmland. Congress has authorized the construction of four major storage units on the Upper Colorado River and its tributaries.

The dams are known as Glen Canyon, which will cost $325,000,000; the Flaming Gorge unit is estimated to cost $67,000,000; and the Navajo Dam, an earth-fill structure on the San Juan River, is expected to cost $42,000,000. The fourth storage facility authorized is the Curecanti unit on the Gunnison River but final plans for this unit have not yet been approved.

An interesting résumé of the Bureau of Reclamation plans for the Upper Colorado River Basin begins on page 80.

° ° °

One never ceases to wonder at the unusual jobs industrial explosives are called upon to do. The most recent unusual job to come to our attention is the salvaging of a lead lining from some abandoned acid vats. The lead sheeting was sandwiched between a concrete outer shell and a brick lining, and its removal presented a challenge that tested both the imagination and technical skill of the contractor, Burnbrae, Inc., of Towson, Maryland.

A step-by-step description of the procedure that accomplished this unusual blasting job begins on page 88.

° ° °

Used for many years in quarrying, open-pit, and certain types of underground mining and construction work, the short-period method of initiating explosives is now being used successfully in underground bituminous-coal mining.

Dennis Plan, an explosives engineer of many years' experience in servicing coal mines in the South, presents a thought-provoking article on this method of blasting. The article tells of the early experiments that proved the feasibility of multiple short-period delay blasting in bituminous-coal mines and the advantages that have resulted by the use of this method. The article starts on page 91.

A new booklet is available describing the use of Short-Period Delay Electric Blasting Caps in many mining, quarrying, and construction operations. If you would like to have a copy, just write to the editor of this publication.

CONTENTS

FRED A. SEATON—*a photograph* 68

FRED A. SEATON—*a biography* 69

The Winners in 1958 70

The National Safety Competition of 1958 71
By JOHN C. MACHISAK

Awards of Certificates of Achievement in Safety—1958 79

Water for the Upper Colorado River Basin 80
By THOMAS E. MILLER

Dynamite Solves Tough Salvage Problem 88
By WILLIAM F. HALLSTEAD

Multiple Short-Period Delay Blasting in Underground Bituminous-Coal Mines 91
By DENNIS V. PLAN

New Notes 94

Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

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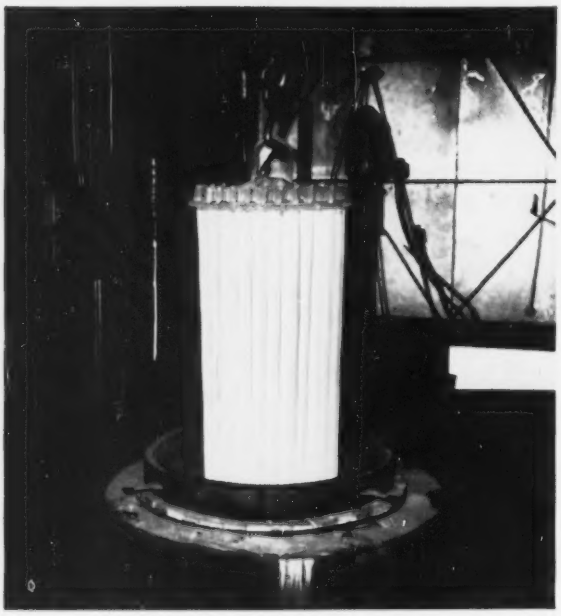
BPA

HARD-HITTING DRILLS

THE SIZE, THE POWER AND

5 ½" hammer diameter—Here's deep hole drilling power that packs plenty of punch. Gardner-Denver DH143 fills the rock drill gap between wagon drill and rotary rig.



Tough and long-lasting—Gardner-Denver drill steel. Emergence from heat-treat furnace shows carburizing process that results in abrasive-resistant exterior and tough inner core.

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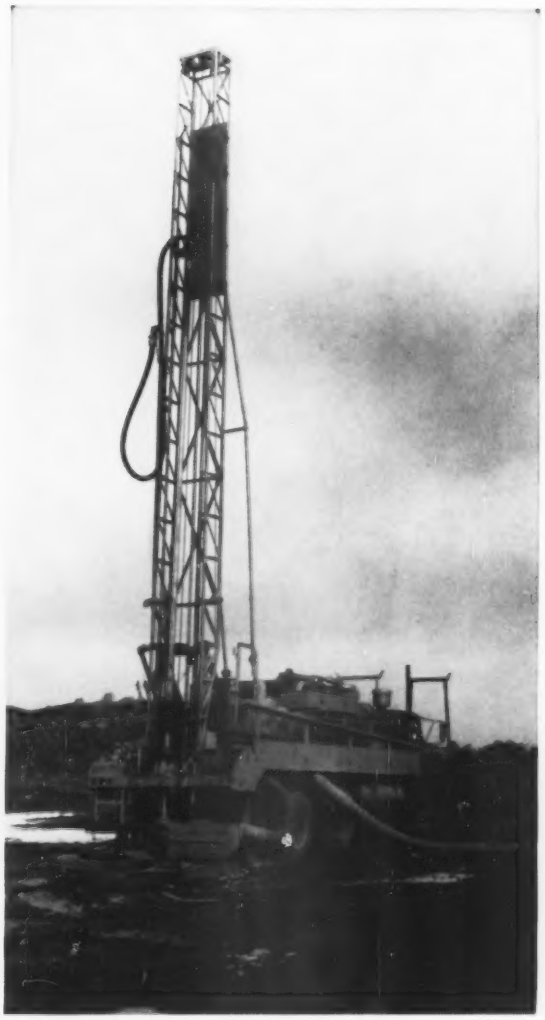

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FRED A. SEATON

Fred A. Seaton

SECRETARY OF THE INTERIOR

A Biography

FRED A. SEATON, Midwest newspaper man, is admirably trained for the task of heading that giant department which attends to the interior of our country. For like another publication which claimed to "cover Dixie like the dew," his publications and radio transmitters cover the Midwest like the wheat and corn.

Born to the newspaper profession, and raised with printer's ink in his nostrils and under his fingernails, Fred Seaton learned about news at his father's knee. He was a composing-room helper before he was out of grade school, and could set type by hand from the type case at the age of nine. To a newspaperman, that puts him about on a par with Mozart playing the harpsichord at the age of three.

Born prophetically in Washington, D. C., Fred attended the Manhattan, Kansas, grade schools and the Manhattan High School, where he engaged in sports and dramatics. At Kansas State College in Manhattan, he expanded his extracurricular activities to include publications, the Little Theatre, and director of sports publicity. In his senior year, he engaged in dramatics so strenuously that while playing the leading role in his college play he fractured his skull, was laid up for several weeks in a hospital, and could not graduate with his class.

Coming out of college, he did what came naturally and became wire news editor of the *Manhattan Chronicle* and city editor of the *Manhattan Mercury* in 1933. He became associate editor of the Seaton publications at Manhattan from 1933 to 1937, and publisher of the Hastings, Nebraska, *Tribune*, from 1937 to date. With his father, Fay N. Seaton, and his brother, R. M. Seaton, he enlarged the family interests to include not only the Manhattan newspapers, but also the papers at Coffeyville and Winfield, Kansas, at Hastings and Alliance, Nebraska, at Sheridan, Wyoming, and at Lead and Deadwood, South Dakota, as well as radio and television stations in some of these locations, and *Western Farm Life*, the farm weekly published at Denver. Fred's father died in 1952, and his mother, Dorothea Elizabeth Schmidt Seaton, now holds various corporate posts in the newspaper, radio, and television group.

Fred was elected a member of the Nebraska unicameral legislature for two terms, from 1945 to 1949, and then was appointed United States Senator from Nebraska on December 10, 1951, to fill the vacancy caused by the death of Nebraska's Senator Kenneth S. Wherry. His real start in politics dates back to the 1930's, when he was a secretary to Governor Alf Landon of Kansas in the 1936 presidential campaign.

He was President Eisenhower's personal campaign advisor in the presidential campaign of 1952, a post he repeated in the 1956 campaign. He was appointed Assistant Secretary of Defense in 1953, leaving that office in 1955 to become, successively, Administrative Assistant and Deputy Assistant to the President. He was appointed Secretary of the Interior by President Eisenhower and was sworn in on June 3, 1956.

Mr. Seaton's Interior policy has been summed up as a sound natural resources policy fostering both conservation and wise use. "The Department of the Interior," says Mr. Seaton, "is keenly aware of the solemn obligation upon the present generation to conserve our physical and scenic resources for our children and children's children. We are conscious, too, that America's high standards of living today provide ample proof that intelligent conservation and orderly development of natural resources are compatible."

Secretary Seaton's term in office has witnessed a number of projects that bear out this policy, notably a program to improve the national park system under the 10-year "Mission 66" program; measures to protect wildlife lands and to increase their number; a proposed long-range minerals program to further research on, and exploration for, mineral resources under United States soil; a vigorous reclamation program, of which the Upper Colorado River Storage Project is the largest and most active at present; and an intensive effort to discover economical means of converting saline water to fresh.

He is past president of the Associated Press Newspapers of Nebraska, and a past president and chairman of the board of directors of the Inland Press Association, as well as an active member of the Nebraska Press Association and the National Editorial Association.

Secretary Seaton is also a trustee of the University of Nebraska Foundation and of Hastings College. He is a member of Beta Theta Pi, Sigma Delta Chi, and Pi Kappa Delta. He is a Mason and a member of B.P.O.E. His club memberships include the University Club in Lincoln, Nebraska, the Hastings Rotary Club, the National Press Club in Washington, D. C., and the Newcomen Society in North America.

Fred Seaton married Gladys Hope Dowd on January 23, 1931, and they have four children, all by adoption: Donald Richard, Johanna Christine, Monica Margaret, and Alfred Noble. Their home is in Hastings, Nebraska, and, at present, at 5810 Hillburne Way, Chevy Chase 15, Maryland.

THE WINNERS IN 1958

Anthracite
GERMANTOWN COLLIERY
RAVEN RUN COAL COMPANY
Centralia, Pennsylvania

Bituminous-Coal
NO. 14 MINE
GARY DISTRICT
UNITED STATES STEEL CORPORATION
Gary, West Virginia

Metal
PIONEER MINE
OLIVER IRON MINING DIVISION
UNITED STATES STEEL CORPORATION
Ely, Minnesota

Nonmetallic
GRAND RAPIDS MINE
BESTWALL GYPSUM COMPANY
Grand Rapids, Michigan

Open-Pit
MINING DEPARTMENT
ERIE COMMERCIAL MINE
PICKANDS MATHER AND COMPANY
Hoyt Lakes, Minnesota

Quarry
THORNTON QUARRY
MATERIAL SERVICE CORPORATION
Thornton, Illinois

"Let the worker carry around with him a mental picture of his wife and child, whose happiness depends upon his safe return after the day's work, and these loved ones become his surest sentinels of safety."

January, 1925—The Explosives Engineer

The National Safety Competition OF 1958

Record of 675 participants was the highest in the history of the competition while injury and severity rates remained low

JOHN C. MACHISAK°

A 34-year record high of 675 mineral operations participated in the 1958 National Safety Competition, sponsored jointly by the U. S. Bureau of Mines and THE EXPLOSIVES ENGINEER. This record participation, distributed throughout 44 states, reflects the growing trend among the Nation's mineral producers and their safety engineers to use every tool available to promote safety on the job. Such contests as the National Safety Competition long have been recognized in the field of safety promotion as an effective means of arousing and holding the interest of employes and officials alike in an accident-prevention program. They also tend to forge each individual precautionary act into a unified group effort—toward winning a common objective, such as the Sentinels of Safety trophy.

The National Safety Competition is conducted annually to further the work of accident prevention in the Nation's mines and quarries. Enrollment is voluntary.

The participating mines and quarries are grouped into six classes: anthracite underground mines, bituminous-coal underground mines, metallic underground mines, nonmetallic underground mines, open-pit mines, and quarries. In each class, the contestant having the lowest injury-severity rate (number of days lost resulting from disabling work-injuries, including fatalities, per million man-hours worked) during the calendar year competition period is declared a winner and is awarded a bronze Sentinels of Safety trophy. These trophies, provided by THE EXPLOSIVES ENGINEER, are awarded as a symbol of national recognition for outstanding performance in safety on the job. If the same injury-severity rate is reported by more than one of the competitors at the close of the competition, the one having the highest total number of man-hours worked becomes the winner. Each of the six winning companies receives a Sentinels of Safety flag, also provided by THE EXPLOSIVES ENGINEER, to be displayed as a daily reminder of what can be accomplished in the field of accident prevention when a safety program is well organized, well administered, and is reinforced by common incentive.

The Bureau of Mines awards every employe and official of the six winning operations an individual Certificate of Accomplishment in Safety in recognition of each man's personal contribution to his company's outstanding safety achievement. The Bureau also awards a Certificate of Achievement in Safety to the next four succeeding plants in each of the six classes in the order of their safety records, and to each mine and quarry entry having a record of working 30,000 or more man-hours without a disabling work-injury during the contest year.

An Excellent Record

The 675 participants in the 1958 National Safety Competition amassed more than 121 million man-hours of exposure to the hazards of mining and quarrying. This was 4 million less than the hours recorded for the 619 operations in the 1957 competition. Disabling work-injuries in 1958 numbered 2,285 of which 58 were fatalities; and the 569,047 days of disability reported resulted in an injury-severity rate of 4,698,329 per million man-hours of work, which is the fourth lowest rate on record. The injury-frequency rate for the 1958 operations was 18.866 per million man-hours, the second lowest injury-frequency rate experienced in the 34 years of competition.

The number of operations represented in the 1958 contest that had no disabling injuries equals the all-time record of 272 established in 1957.

°Chief, Branch of Accident Analysis
Division of Safety, Bureau of Mines
United States Department of the Interior
Washington, D. C.

RAVEN RUN MINERS: Employes of the Raven Run Coal Company, Germantown Colliery, winners of the National Safety Competition in the anthracite division, are pictured beside the shaft frame.

These injury-free participants accumulated more than 25 million man-hours of work exposure during the 1958 contest. Mines and quarries that reported no disabling injuries are distributed as follows: bituminous-coal underground mines, 12; metallic underground mines, 11; nonmetallic underground mines, 25; open-pit mines, 62; and quarries, 162. The five top-ranking entries in each of the foregoing classes were injury-free operations; consequently, winners in these five classes were determined on the basis of the number of man-hours worked. No disabling injury-free operations were recorded in the anthracite underground mine group in 1958.

Top honors in the 1958 National Safety Competition were awarded to:

Anthracite: Germantown Colliery of Centralia, Pennsylvania, operating in Columbia, Schuylkill, and Northumberland Counties, Pennsylvania. Mine is operated by Raven Run Coal Company.

Bituminous-Coal: No. 14 Mine, Gary, McDowell County, West Virginia. Mine is operated by United States Steel Corporation.

Metal: Pioneer Mine, Ely, St. Louis County, Minnesota. Mine is operated by Oliver Iron Mining Division, United States Steel Corporation.

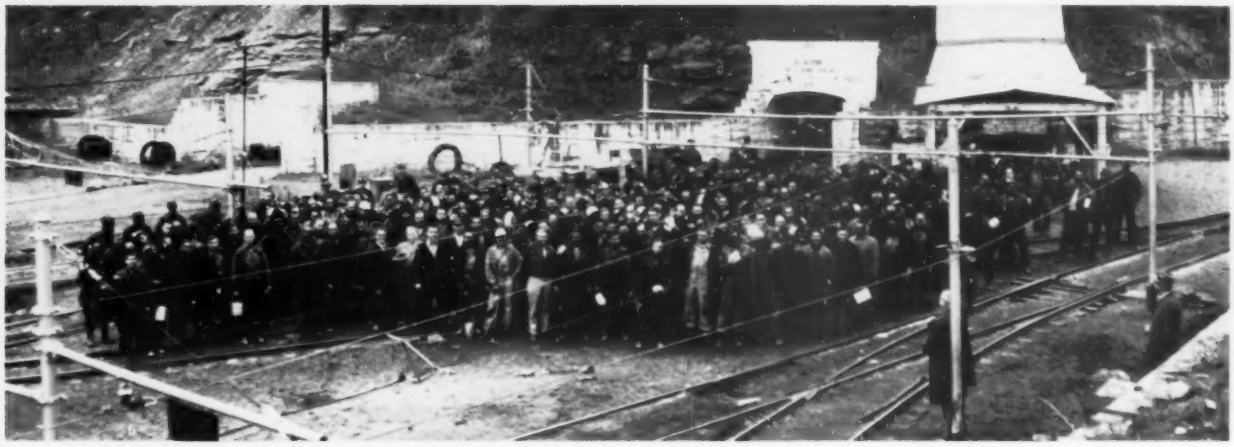
Nonmetallic: Grand Rapids Mine, Grand Rapids, Kent County, Michigan. Mine is operated by Bestwall Gypsum Company.

Open-Pit: Erie Commercial Mine, Hoyt Lakes, St. Louis County, Minnesota. Mine is operated by Pickands Mather and Company.

Quarry: Thornton Quarry, Thornton, Cook County, Illinois. Quarry is operated by Material Service Corporation.

Rules of the National Safety Competition provide that a Committee of Award make the final determination of the winner in each class after the committee has carefully studied the records of the leading contestants for the Sentinels of Safety trophy. Members of the Committee of Award who selected the 1958 winners of the Sentinels of Safety trophy were: Frank F. Kolbe, president, National Coal Association; Howard G. Pyle, president, American Institute of Mining, Metallurgical, and Petroleum Engineers; G. Donald Kennedy, president, Portland Cement Association; Howard Pyle, president, National Safety Coun-

GERMANTOWN COLLIERY: Some of the surface facilities of the Germantown Colliery of the Raven Run Coal Company. Included in the picture are the shaft headframe and auxiliary buildings of the Merriam Section of the anthracite mine.



COAL MINERS: Employes of No. 14 Mine of United States Steel Corporation who helped win the top award in the bituminous-coal group.

cil; Charles Ferguson, director, Safety Division, United Mine Workers of America; Raymond E. Salvati, president, American Mining Congress; and Hugo E. Johnson, president, American Iron Ore Association.

Anthracite Mines

Raven Run Coal Company's Germantown Colliery of Centralia, Pennsylvania, operating in Columbia, Schuylkill, and Northumberland Counties, Pennsylvania, won the Sentinels of Safety trophy in this class with an injury-severity rate of 1,452.223. Employes of this winning entry suffered 21 disabling work-injuries during the contest year, resulting in 604 days of disability while working 415,914 man-hours exposed to the hazards of underground mining of anthracite. The winning severity rate of 1,452.223 per million man-hours of work is somewhat better than the 1,938.9 severity rate posted by the 1957 winner in this classification. The Germantown Colliery won the Sentinels of Safety trophy in the 1955 competition and has been enrolled in the National Safety Competition every year since 1944.

As a group, the 1958 anthracite participants posted the lowest injury-frequency rate (57.873) and the lowest injury-severity rate (4,520.405) per million man-hours of work for this classification in the 34-year history of the competition.

Bituminous-Coal Mines

The Number 14 Mine of the United States Steel Corporation, Gary, McDowell County, West Virginia, won the Sentinels of Safety trophy for the best safety record in 1958 among underground bituminous-coal mines. The mine accumulated 693,817 man-hours in 1958 without a disabling work-injury. This is the first time the Number 14 Mine has won the trophy.

During its ten consecutive years of participation in the National Safety Competition, the Number 14 Mine has worked slightly more than 10 million man-hours, with an injury-frequency rate of 11.455 and an injury-severity rate of 3,246.776 per million man-hours of exposure to the hazards of under-

NO. 14 MINE: United States Steel Corporation's No. 14 Mine at Gary, West Virginia, which won the top award in the bituminous-coal group. U.S. Steel also won first place in the underground metal-mine group.

UNDERGROUND SAFETY MOVIE: The day-shift mine crew attending a safety movie underground at Pioneer Mine of Oliver Iron Mining Division, U. S. Steel. Shown here are some of the men responsible for this mine's perfect safety record in 1958.

ground mining of bituminous coal.

One hundred and twenty-four underground bituminous-coal mines participated in the 1958 competition. They reported 1,003 disabling work-injuries, of which 24 were fatalities, while operating more than 39 million man-hours. As a result, the underground bituminous-coal group's injury-frequency rate was 25.318 and its injury-severity rate was 6,073.510 per million man-hours of work in 1958.

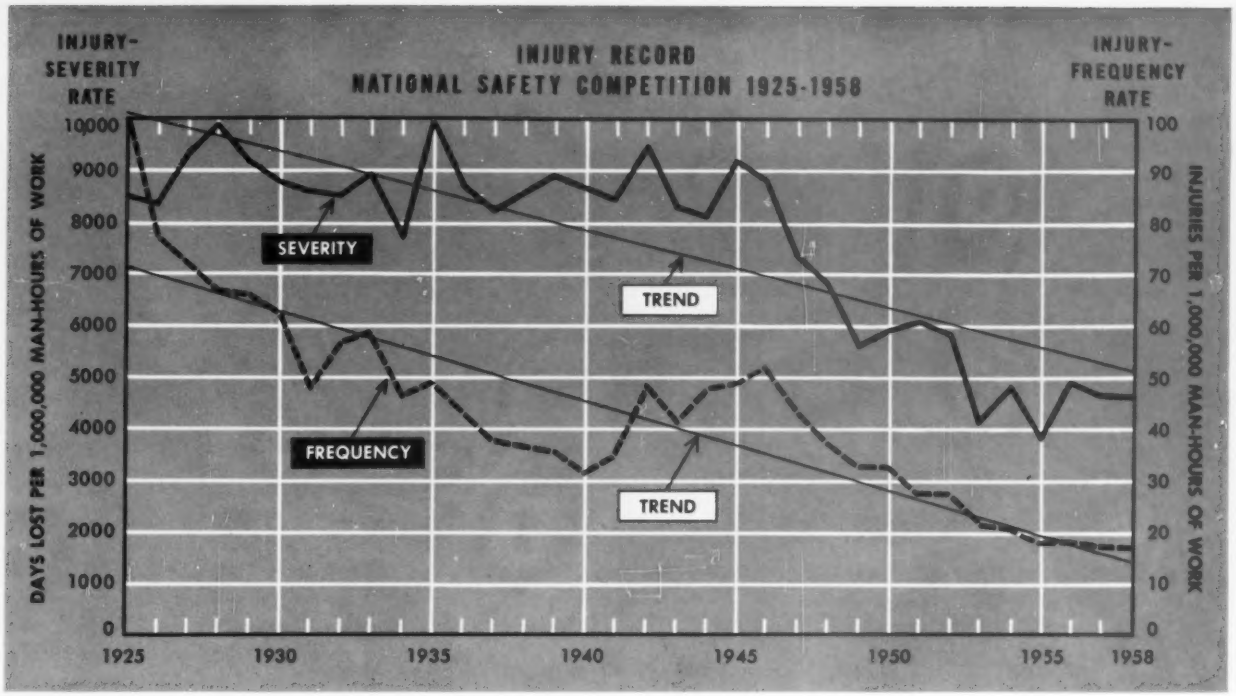
Participation by underground bituminous-coal mines rose 85 percent to 124 in 1958. This is nearly double the 67 mines that competed in 1957.

Metal Mines

The Pioneer (iron-ore) Mine, operated by the Oliver Iron Mining Division of United States Steel Corporation, Ely, St. Louis County, Minnesota, achieved the award-winning safety record in the underground metal-mining group of the 1958 National Safety Competition. The employes of this mine were exposed 713,118 man-hours to the hazards of underground metal mining during the year without suffering a disabling work-injury. This mine participated in only one other National Safety Competition, that of 1951.

The 52 mines participating in this group amassed more than 18 million man-hours and experienced 398 disabling work-injuries, 14 of which resulted in fatalities. The resulting injury-frequency rate for the group in 1958 is 21.716, and the injury-severity rate is 6,363.418 per million man-hours

SHAFT HEADFRAME: The Pioneer "A" shaft headframe of the Oliver Iron Mining Division, U. S. Steel Corporation, at Ely, Minnesota.



SALIENT FEATURES OF THE NATIONAL SAFETY COMPETITION

1958

Type of mine	*Number of mines*	*Man-hours*	*Fatal injuries*	*Nonfatal injuries*	*Total injuries*	*Days of disability*	*Frequency rate*	*Severity rate*
Anthracite	9	2,695,555	—	156	156	12,185	57.873	4,520.405
Bituminous-coal	124	39,615,314	24	979	1,003	240,604	25.318	6,073.510
Metal	52	18,327,730	14	384	398	116,627	21.716	6,363.418
Nonmetallic mineral	57	7,578,413	4	173	177	34,364	23.356	4,534.459
Total	242	68,217,012	42	1,692	1,734	403,780	25.419	5,919.051
Open-pit	146	30,224,743	6	274	280	70,751	9.264	2,340.830
Quarries	287	22,675,140	10	261	271	94,516	11.951	4,168.265
Grand total	675	121,116,895	58	2,227	2,285	569,047	18.866	4,698.329

THE 34-YEAR HISTORY OF THE NATIONAL SAFETY COMPETITION

1925-1958

(CUMULATIVE FIGURES)

Type of mine	*Man-hours*	*Fatal injuries*	*Nonfatal injuries*	*Total injuries*	*Days of disability*	*Avg. Frequency rate*	*Avg. Severity rate*
Anthracite	668,523,958	784	38,232	39,016	6,978,062	88.278	10,438.013
Bituminous-coal	1,578,776,017	1,512	62,961	64,473	14,304,683	40.837	9,060.616
Metal	625,274,729	476	21,136	21,612	4,186,159	34.564	6,694.912
Nonmetallic mineral	170,060,960	97	4,496	4,593	866,641	27.008	5,096.061
Total	3,042,635,664	2,869	146,825	149,694	26,335,545	49.199	8,655.504
Open-pit	429,562,951	115	6,276	6,391	1,124,976	14.878	2,618.885
Quarries	600,818,332	274	10,677	10,951	2,500,748	18.227	4,162.237
Grand total	4,073,016,947	3,258	163,778	167,036	29,961,269	41.010	7,356.038

BESTWALL GYPSUM MINERS: Miners of the Grand Rapids Mine of the Bestwall Gypsum Company, who helped that mine achieve the best record in the nonmetallic group, appear before a safety billboard at the mine.

of work in underground metal mines.

Nonmetallic Mines

The award for top safety performance in the underground nonmetallic mine group during 1958 was bestowed on the Grand Rapids Mine of the Bestwall Gypsum Company, Grand Rapids, Kent County, Michigan. This mine operated without a disabling work-injury in 1958 for a total of 220,111 man-hours.

The Grand Rapids Mine enrolled for the first time in 1926. It then dropped out until 1937, when it became a regular participant in the National Safety Competitions through 1953. During this period, it did not receive the trophy; however, it did receive honorable mention in 1944. It did not compete again until 1958. During its 19 years of competition it accumulated almost 1½ million man-hours and experienced 88 disabling work-injuries, none of which was fatal. This reflects an injury-frequency rate of 29.874, and an injury-severity rate of 1,344.312 per million man-hours.

The Grand Rapids Mine contended with 56 other underground nonmetallic mines. This is the second highest number of participants in this group, surpassed only by the 1954 competition's 58 contestants. The 57 mines in the 1958 group worked more than 7½ million man-hours. Their employes suffered 177 disabling work-injuries, 4 of which were fatalities. During 1958, this group's injury-frequency rate was 23.356, and its injury-severity rate was 4,534.459 per million man-hours of exposure.

Open-Pit Mines

In the open-pit mine category of the 1958 National Safety Competition, the Sentinels of Safety trophy was won by the Erie Commercial Mine, operated by Pickands Mather and Company, Hoyt Lakes, St. Louis County, Minnesota. The mine worked almost 1¼ million man-hours in 1958 without a lost-time injury. It is the second time since its enrollment in 1955 that this mine has been awarded top honors in this competitive group, and in each of the winning years it has attained the ultimate in safety—an injury-free operation throughout the contest year.

The Erie Commercial Mine worked 558,010 injury-free man-hours during 1955, and in 1958 it worked 1,235,226 man-hours without injury. During its four years of competition, this mine has worked more than 4 million man-hours and has reported only 8 disabling work-injuries (one was a fatality). Its four-year injury-frequency rate was 1.920, and its injury-severity rate 1,561.216 per million man-hours of work exposure.

GRAND RAPIDS PLANT: The Bestwall Gypsum surface buildings at the company's Grand Rapids, Kent County, Michigan, plant.

With a total of 146 open-pit mines entered in the 1958 National Safety Competition, an all-time participation record was established for this group. This represents an increase of 43 over the previous high of 103 participants in the open-pit mine group of 1953. These 146 open-pit mines worked more than 30 million man-hours in 1958, recording 280 disabling work-injuries (6 were fatalities). The injury-frequency rate was 9.264, and the injury-severity rate was 2,340,830 per million man-hours of exposure to the hazards of this method of mining.

Quarries

For the second time in five years, the Sentinels of Safety trophy for the quarry group was awarded the Thornton Quarry of the Material Service Corporation, Thornton, Cook County, Illinois. In 1958 the quarry worked 437,100 man-hours without a disabling work-injury. During the other winning year—1954—no lost-time injuries occurred during the 457,570 man-hours worked. This quarry placed second in the 1956 competition: again, with a perfect safety record throughout 434,020 man-hours of operation.

More than 2 million man-hours have been accumulated by Thornton Quarry over a period of five years of active participation in the National Safety Competition. During this time, 14 disabling work-injuries have been recorded, resulting in an injury-frequency rate of 6.661 and an injury-severity rate of 3,933.891 per million man-hours of exposure.

ERIE SAFETY MEN: Superintendent, foremen, and safety committeemen who planned and carried out the safety program in Erie Mining Company's open-pit operations at Hoyt Lakes, Minnesota, which won them first place in that group.

The 287 quarries in the 1958 competition worked more than 22½ million man-hours and reported 271 disabling work-injuries, 10 of which were fatalities. The injury-frequency rate was 11.951, and the injury-severity rate 4,168.265 per million man-hours of work.

The number of quarries in the 1958 National Safety Competition decreased to 287, from a record high of 334 established in 1957.

Rules of the Competition

All mines and quarries in the continental United States are eligible to

TACONITE TRAIN: A typical ore train of eight 80-ton side-dump cars and locomotive begins the two-mile haul to the coarse-crusher plant of Erie Mining Company. In the background are the jet piercer, oxygen trailer, and water trailer—the equipment used to pierce holes in the extraordinarily hard rock. This operation worked 1,235,226 injury-free man-hours during the 1958 contest year.

THORNTON QUARRY STAFF: The foreman, safety men, and superintendent of the quarry who were responsible for the safety program in 1958.

enter the National Safety Competition. However, in order to compete for the Sentinels of Safety trophy, a participant must have worked at least 100 days and must have accumulated 30,000 or more man-hours of exposure to the hazards of mining or quarrying during the contest year; that is, from January 1 through December 31. Rules also require that competing mines and quarries submit to the Federal Bureau of Mines an official report of each disabling work-injury sustained during the contest year, together with certain related employment data. Beginning with the 1959 competition all entrants, except anthracite underground mines and bituminous-coal underground mines, will be required to supply this information on a quarterly basis instead of monthly, as heretofore.

Rules of the competition state that all entrants must be enrolled not later than April 1 of the contest year, and that all fourth-quarter reports must be filed on or before February 15 of the year immediately following the close of the contest.

Application forms for enrollment in the National Safety Competition and copies of the contest rules may be obtained from the Bureau of Mines, U. S. Department of the Interior, Division of Safety, Branch of Accident Analysis, Washington 25, D. C., or from any of the field offices of the Bureau of Mines.

QUARRY FACE: A portion of the Thornton Quarry of Material Service Corporation is spanned by the recently completed Illinois Toll Road. The quarry shipped a substantial part of its 1958 stone production to the toll highway project which connects on the east end with the Indiana Tollway.

Awards of Certificates of Achievement In Safety—1958

RULES of the competition provide for the award of Certificates of Achievement in Safety to each mine or quarry, other than the trophy winners, whose position in the contest was among the first four in its respective group. These mines and quarries are listed below.

Certificates are also awarded each injury-free mine or quarry that worked 30,000 or more man-hours during the 12 consecutive months of each contest. We regret that space limitations do not permit listing all of the recipients.

ANTHRACITE MINES

Penag Mine, Goodspring, Schuylkill County, Pennsylvania, operated by the Penag Coal Company. Worked 130,948 man-hours with 18 lost-time injuries causing 235 days of disability. Injury-severity rate was 1,794.605 per million man-hours.

Stockton Mine, Stockton, Luzerne County, Pennsylvania, operated by the Jeddo-Highland Coal Company. Worked 156,352 man-hours with 14 lost-time injuries causing 412 days of disability. Injury-severity rate was 2,635.080 per million man-hours.

Loree-Boston Mine, Plymouth, Luzerne County, Pennsylvania, operated by The Hudson Coal Company. Worked 362,811 man-hours with 22 lost-time injuries causing 1,044 days of disability. Injury-severity rate was 2,877.531 per million man-hours.

Loree 2, 4, and 5 Mine, Plymouth, Luzerne County, Pennsylvania, operated by The Hudson Coal Company. Worked 738,644 man-hours with 31 lost-time injuries causing 2,465 days of disability. Injury-severity rate was 3,337.196 per million man-hours.

BITUMINOUS-COAL MINES

Hamilton Mine, Pratt City, Jefferson County, Alabama, operated by the Tennessee Coal and Iron Division, United States Steel Corporation. Worked 455,762 man-hours without a lost-time injury.

Labuco Mine, Birmingham, Jefferson County, Alabama, operated by the Alabama By-Products Corporation. Worked 140,687 man-hours without a lost-time injury.

Bell Creek Mine, Cedar Grove, Kanawha County, West Virginia, operated by the Electro Metallurgical Company, Division of Union Carbide Corporation. Worked 124,042 man-hours without a lost-time injury.

D. O. Clark Mine, Superior, Sweetwater County, Wyoming, operated by The Union Pacific Coal Company. Worked 123,892 man-hours without a lost-time injury.

METAL MINES

Soudan Underground Mine, Soudan, St. Louis County, Minnesota, operated by the Oliver Iron Mining Division, United States Steel Corporation. Worked 396,095 man-hours without a lost-time injury.

Wenonah No. 7 Mine, Bessemer, Jefferson County, Alabama, operated by the Tennessee Coal and Iron Division, United States Steel Corporation. Worked 265,398 man-hours without a lost-time injury.

Edwards Mine, Bessemer, Jefferson County, Alabama, operated by the Republic Steel Corporation. Worked 223,715 man-hours without a lost-time injury.

Zenith Mine, Ely, St. Louis County, Minnesota, operated by the Vermillion Mining Company (Pickands Mather and Company). Worked 168,173 man-hours without a lost-time injury.

NONMETALLIC MINES

Bellefonte Mine, Bellefonte, Centre County, Pennsylvania, operated by the National Gypsum Company. Worked 217,981 man-hours without a lost-time injury.

Akron Mine, Akron, Erie County, New York, operated by the Bestwall Gypsum Company. Worked 213,004 man-hours without a lost-time injury.

Bell Mine, Bellefonte, Centre County, Pennsylvania, operated by the Warner Company, Bellefonte Division. Worked 188,925 man-hours without a lost-time injury.

Jonathan Mine, East Fultonham, Muskingum County, Ohio, operated by the Columbia-Southern Chemical Corporation, Columbia Cement Division. Worked 157,109 man-hours without a lost-time injury.

OPEN-PIT MINES

Mississippi Group Mine, Keewatin, Itasca County, Minnesota, operated by the Hanna Ore Mining Company. Worked 425,737 man-hours without a lost-time injury.

Orange Park Mine, Lakeland, Polk County, Florida, operated by the American Cyanamid Company. Worked 322,912 man-hours without a lost-time injury.

Sydney Mine, Sydney, Hillsborough County, Florida, operated by the American Cyanamid Company. Worked 307,088 man-hours without a lost-time injury.

Desert Mound Mine, Cedar City, Iron County, Utah, operated by the Columbia Iron Mining Company. Worked 294,749 man-hours without a lost-time injury.

QUARRIES

Clinton Point Quarry, New Hamburg, Dutchess County, New York, operated by the New York Trap Rock Corporation. Worked 336,330 man-hours without a lost-time injury.

Hillsville Quarry, New Castle, Lawrence County, Pennsylvania, operated by the Michigan Limestone Division, United States Steel Corporation. Worked 301,643 man-hours without a lost-time injury.

Cedarville Quarry, St. Ignace, Mackinac County, Michigan, operated by the Michigan Limestone Division, United States Steel Corporation. Worked 247,899 man-hours without a lost-time injury.

Bridgeport Quarry, Bridgeport, Montgomery County, Pennsylvania, operated by the Bethlehem Steel Company. Worked 243,154 man-hours without a lost-time injury.

Water for the Upper Colorado River Basin

Vast area of 110,000 square miles is dependent upon the development of water-storage project of the Bureau of Reclamation

THOMAS E. MILLER

THE Upper Colorado River drainage basin covers 110,000 square miles, an area larger than New York, Pennsylvania, and New Jersey combined. This area, bounded on the east and north by the Continental Divide and by other Rocky Mountain ranges on the west, is one of the most arid regions in the whole of the United States. Embracing parts of Wyoming, Utah, Colorado, Arizona, and New Mexico, this barren waste is possibly the most sparsely populated of any large area in the continental United States.

The sparse population of the region is without doubt a direct result of the lack of water. The 1957 population was estimated to be about 412,000 people in the basin, a density of 3.75 persons per square mile compared to a national average of 57.8 persons a square mile (based on land area). About 92% of the people are white, the nonwhites being largely Indians; 20,000 Indians live in the San Juan River basin and about 1,200 live in the Uinta basin. Grand Junction, Colorado, with a population of over 16,000 (1957 estimate) is the largest town, the size of this population being largely attributable to Federal reclamation projects which were constructed early in the century.

Two Percent of Land Irrigated

The lack of water is evident in the uses to which the land is put. Of the 70,000,000 acres, about 70% is classified as grazing land; and, in addition, much of the national forest lands are grazed. Only 2% of the area is irrigated, while an additional 0.4 of 1% is cultivated without irrigation, a statistic eloquent in its implications of the need for water. Of the grazing land, 41.5% is publicly owned; and if state and county land, Indian reservations, and national forests and parks are included, 77.9% is public land.

Farming without irrigation is such a discouraging effort that little land is put to this use. The farmer is caught between two millstones, for at altitudes where the rainfall is sufficient for him to get by without irrigation, the season is too short to make a crop.

Two-Thirds of River Flow Is Spring Floods

The meager supplies of moisture that come to the area are not such that full use can be made of them. Most of the precipitation falls as snow in the mountain ranges. The thaws in the late spring and early summer send torrential floods down the river valleys; this runoff in April, May, June, and early July accounts for more than two-thirds of the flow at Lee Ferry, Arizona, the point chosen as the division between the upper and the lower Colorado River drainage basin. Because the upper basin must honor compact commitments to let a specified volume of water flow downstream to the lower basin, a system of storage reservoirs is necessary to catch this seasonal runoff and even to store water from years of plentiful rainfall to years of drought if the upper basin users are going to have a firm water supply.

To rescue this arid region from the consequences of lack of water, the Bureau of Reclamation of the United States Department of the Interior has been authorized by Congress to undertake the Colorado River Storage Project, a vast system of dams, power-generating stations, and irrigation canals which will rival Hoover Dam in magnitude.

Four major storage units have been authorized for construction on the upper Colorado River and its tributaries above Lee Ferry. Hydropower generating facilities and transmission lines would be provided for three of the units. The storage thus provided would total 34,670,000 acre-feet.

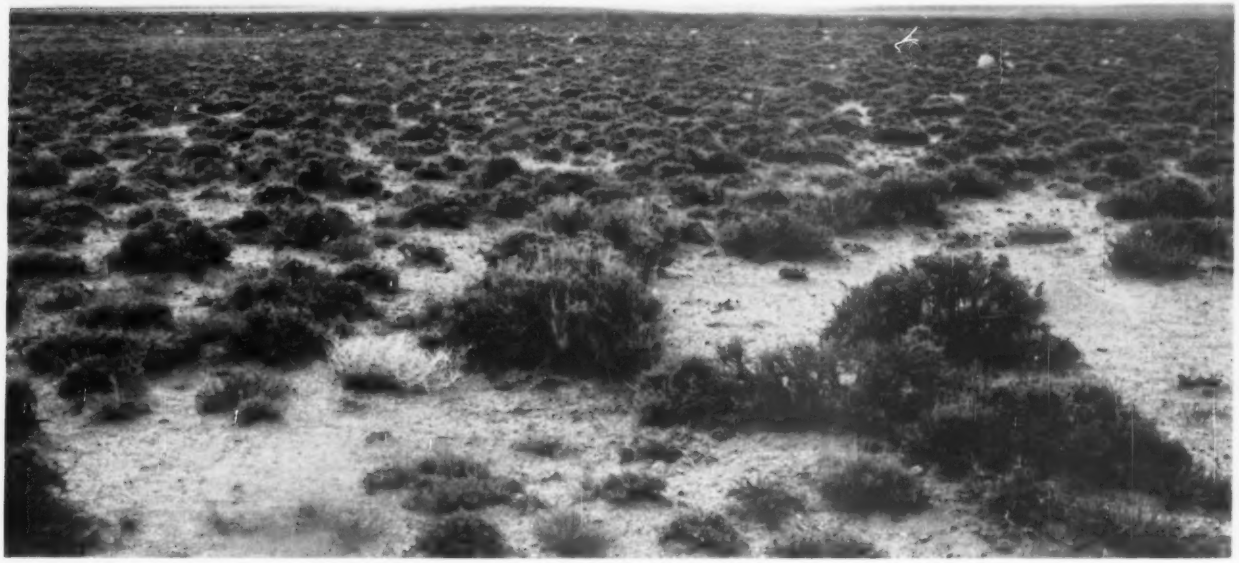
The Four Dams

The highest of the dams is Glen Canyon Dam on the Glen Canyon, 17 miles above Lee Ferry, a concrete, arch-type structure 700 ft. high from bedrock, almost as high as Hoover Dam, and estimated to cost $325,000,000. This dam will play an important part in controlling water releases to the lower Colorado. It will impound the heavy silt accumulations that are gradually reducing the amount of storage space in Lake Mead, the reservoir created by Hoover Dam. The power-generating plant will have a total installed capacity of 900,000 kw. At its peak it will produce more than 5,000 million kw.-hrs. annually, but as water for various purposes is taken from the upper river, this production will be reduced about one-third. The reservoir created by the dam will have an initial capacity of 28 million acre-feet and will extend 186 miles up the Colorado River and 71 miles up the San Juan River.

The second dam, in point of progress in construction to date, is the Flaming Gorge unit, now being constructed at a cost of nearly $67,000,000. This dam, on the Green River about 29 miles downstream from the Utah-Wyoming state line, is a concrete, thin arch-type structure 495 ft. high.

The Flaming Gorge reservoir to be formed by the dam will have a total initial capacity of 3,789,000 acre-feet, a water surface area of 40,800 acres, and will extend upstream 91 miles to within 3 or 4 miles of the town of Green River, Wyoming. The power plant will consist of three units with a total installed capacity of 108,000 kw.

A third storage dam, the Navajo unit, is under construction on the San Juan River in New Mexico, at an estimated cost of more than $42,000,000. Unlike Glen Canyon and Flaming Gorge Dams, which are to be made of concrete, Navajo Dam will be an earth-fill structure. It will be about 405 ft. high from foundation, and will create a reservoir having a capacity of 1,712,000 acre-feet. The reservoir will



ARID LAND: Wyoming sagebrush in the Eden Project area is typical of the dry, barren land in the upper Colorado River basin which could be made into productive farmland with irrigation water.

WATER FOR COLORADO CROPS: The Paonia Project in northern Colorado now gets water diverted at Somerset, Colorado, into the Fire Mountain Canal. With the construction of the Paonia Dam, supplemental water flowing through this canal, which would be enlarged, would be provided for 13,200 acres, and 2,200 additional acres would come under irrigation.

have about 15,300 acres surface area and will back water 34 miles up the San Juan River.

The San Juan River is a particularly heavy silt contributor to the Colorado, and retention of sediment will be a major purpose of this structure. It is estimated that over a 100-year period, approximately 330,000 acre-feet of sediment will be captured in the reservoir. Most of the silt, settling to the bottom, will replace inactive storage which is not usable for other purposes. No power will be generated at Navajo Dam.

When all the project hydropower units are coordinated, they will produce more than 600 million kw.-hrs. annually. In the distant future with increasing depletions for consumptive use, this will be reduced some 10 to 20%.

A fourth storage unit authorized for construction is the Curecanti unit on the Gunnison River in Colorado. Final plans for this unit have not been approved; consequently, no construction work has as yet been undertaken.

The upper basin will be enabled to use a share of Colorado River water by a series of irrigation units, called participating projects. Ten of these have been authorized. They are designed to irrigate over 115,000 acres of currently dry land and also to supply supplemental irrigation water to about 231,000 acres of land. Several of the participating projects will also supply water to various municipalities for domestic and industrial use. Other potential participating units are under study.

The Bureau of Reclamation has determined the economic justification for the Colorado Storage Project by an extensive investigation of costs on the project compared with benefits expected to ensue. The benefits anticipated from the project include river regulation for irrigation, municipal and industrial water supply, power generation, sediment retention, flood control, fish and wildlife conservation, and recreation. While it is possible to place monetary values on all of these, only the values produced from irrigation and power generation have been totaled.

Irrigation Benefits

Irrigation benefits, amounting to $15,621,000 annually, loom large in the possible good to come of the river storage project. Power conceivably can be brought in from outside the basin; in fact, it is now being brought to some parts from Montana and other neighboring states.

Water, however, is a different matter. Since water in this section of the country is the very lifeblood of the land, the supply of it, as might be imagined as coming down through the channels and canyons of the Colorado, has already been the subject of negotiation between the five states involved in the upper Colorado River basin, and the five states of the lower basin, and between the United States and Mexico. The Colorado River Compact of 1922 allocates waters to the upper and lower basins. Waters allocated among

the states of the upper basin are divided among them by the Upper Colorado River Basin Compact of 1949, while the Mexican Water Treaty of 1945 defines Mexico's right to the use of water from the Colorado.

Subject to various qualifications, such as damage to the system, prolonged serious drought, and so forth, the division of the water is apportioned by these treaties in this wise: the upper basin and the lower basin each are to receive 7,500,000 acre-feet annually. The upper basin shall not deplete the flow below 75,000,000 acre-feet at Lee Ferry for any consecutive ten-year period. The states of the upper basin may not withhold water, nor the states of the lower basin require the delivery of water which cannot reasonably be applied to domestic and agricultural uses. Of the water going to the states of the upper basin, Arizona, which has a small area in the upper basin, is apportioned 50,000 acre-feet a year, and the remainder of the water is divided as follows: Colorado 51.75%, New Mexico 11.25%, Utah 23.00%, and Wyoming 14.00%. The United States undertakes to deliver to Mexico 1,500,000 acre-feet annually, which jumps to 1,700,000 when there is a surplus in excess of the amount necessary to supply uses in the United States and the guaranteed quantity of 1,500,000 acre-feet allotted to Mexico.

Stream Flow Computation

Stream flow computations have been made at a number of stations on the Colorado, showing that the average annual flow for the period 1914-1947 was 13,633,000 acre-feet at Lee Ferry. With the completion of the authorized projects, water-consuming uses would deplete the flow at Lee Ferry by 3,644,000 acre-feet, leaving 3,856,000 acre-feet of the 7,500,000 acre-feet apportioned to the upper basin. The present and the authorized consumptive use and the quantity remaining for future development are shown in the following table:

Present and Future Consumptive Use, Upper Basin

State	*Annual Apportioned Use (acre-feet)*	*Annual Present and Authorized Use (acre-feet)*	*Annual Use Remaining for Future Development (acre-feet)*
Arizona	50,000	11,000	39,000
Colorado	3,855,000	2,012,000	1,843,000
New Mexico	838,000	168,000	670,000
Utah	1,714,000	992,000	722,000
Wyoming	1,043,000	461,000	582,000
Total	7,500,000	3,644,000	3,856,000

IRRIGATING PINTO BEANS: A Grand Junction, Colorado, farmer applies the water to field of pinto beans.

Power Benefits

Annual benefits expected from making power available to the area are valued at $42,812,000. These benefits are the average annual value of the total estimated cost of obtaining equivalent power from the most economical alternative source likely to be developed in the absence of the storage project and participating projects. Steam-electric plants constructed and operated by private utilities are considered the most likely alternative source.

Cost of Project

Cost of the total project is estimated at $1,003,550,000, exclusive of some costs for specific fish and wildlife and recreational facilities. Of this total $614,264,000 has been allocated to power, $329,524,000 to irrigation, and lesser amounts allocated to such benefits as municipal and industrial water, flood control, etc. Congress has authorized expenditure of $760 million. Annual benefits are estimated at $61,393,000, compared with annual costs of $47,138,000, a ratio of 1.3 to 1.

These estimated costs and benefit ratios are important because of the criticism leveled against most such power and irrigation projects of the Bureau of Reclamation. The attacks against reclamation coming, in the view of the sponsors of the project, mostly from Easterners unfamiliar with the problems of the West, charge "needless waste," socialism, and special privilege.

Reclamation has been stoutly defended by Westerners on the ground that it is good business for the Nation as a whole. Reclamation pays its own way, and extends its effects to many parts of the economy, advantages which cannot be claimed for many other Federal expenditures. While admitting that reclamation of western lands is expensive, the Westerner points out that the dredging of rivers and harbors also is costly, and that the very existence of many of our port cities is dependent upon the expenditure of Federal funds to keep rivers and harbors open for the navigation and water-borne commerce upon which their citizens are dependent for their livelihood. Flood-control measures undertaken by the Federal Government are similarly expensive. Unlike reclamation, there is no requirement that these costs for flood control and river and harbor improvement be repaid.

A further argument advanced for reclamation is that it actually returns most of the construction costs to the Treasury of the United States. Farmers, and other water and power users who directly benefit from Federally financed reservoirs, dams, and hydroelectric plants, repay the construction costs over a set span of years, says the Bureau.

However, the Bureau says that because of the relatively high cost, the irrigation or participating projects could not be entirely paid for by those who would benefit directly. The far-reaching indirect benefits, however, would justify the giving of financial assistance for pay-back of these costs from other sources, particularly from the power revenues.

Large Revenues from Public Lands

Much of the capital required for the construction of the Federal reclamation works in the Western United States comes from the Reclamation Fund, although the Colorado River Storage Project is financed from a sep-

FRUITGROWERS' PROJECT: The Fruitgrowers Reservoir in Colorado supplies water for these productive fields and orchards. The arid areas on each side of the cultivated strip show the land without the benefit of irrigating water.

GLEN CANYON AT NIGHT: Glen Canyon unit under construction makes a striking scene at night. The roadway at right goes to the left spillway, and the lights on the right of the river are at the north portal of the left diversion tunnel.

arate fund created by Congressional action. The Reclamation Fund represents proceeds accruing to the United States from the Oil Leasing Act, from the sale and leasing of public lands, and other public land revenues. Much of the land in the West is owned outright by the Federal Government, which leases desirable acreage for mining, grazing, and oil production. This argument has been ably advanced by Governor George D. Clyde of Utah, one of two Western States in which 70% of the land is owned by the Federal Government. Accretions to the Reclamation Fund from its establishment to June 30, 1958, totaled $531,337,000 and collections representing construction repayments, water rentals, power revenues, and miscellaneous revenues amounted to an additional $734,900,000.

Presenting the case for reclamation, Governor Clyde says, "Whole areas of the West must stagnate, must decline without water. They can only grow through water development. Croplands of California and Arizona producing fruit, cotton, vegetables, and cattle for the national market play a role in the economy of the entire United States—as do aircraft plants and aluminum factories in the Pacific Northwest which depend upon reclamation projects for hydroelectric power. . . .

"What is the Colorado River Storage Project? Designed to serve an area of 100,000 square miles described as the Nation's last frontier, it will provide water—that most valuable fuel of all—for agricultural development and the progressive growth of cities and towns in much of Colorado, New Mexico, Utah, and Wyoming. The program provides four large mainstream dams and ten participating projects. Regulating the river against floods and preventing further silting at Hoover Dam, creating power and making water available for municipal use are part of the multipurpose uses of project waters, along with the provision of agricultural water supplies. Among those who will benefit as water reaches new farmland, and as supplementary water reaches old croplands, are members of the Navajo Indian tribe, a people badly needing economic aid and security. In creating new, stable,

GLEN CANYON CONSTRUCTION: Looking downstream showing the spillways and the right keyway under excavation. The large building on the left is the steel-bending building of the Kiewet-Judson Pacific Murphy Company, contractors.

multimillion dollar markets for such eastern products as autos and tractors, clothing and home furnishings, the Colorado River water storage project will not only parallel—but vastly exceed—the proven benefits brought by such a comparatively small reclamation project as the Strawberry (a notably successful irrigation project in Utah)."

Fish and Wildlife and Recreation Benefits

Effects of the participating projects on fish and wildlife resources, both beneficial and adverse, have been partially evaluated by the Fish and Wildlife Service. The net benefits for the projects studied were found to be $294,000 annually. No evaluation, however, has been made yet of the effects of the storage units on fish and wildlife. The example of Lake Mead suggests that the net benefits of large storage reservoirs may be substantial. Further evaluation of fish and wildlife benefits will be made.

The recreational benefits of the authorized projects and units analyzed to date are estimated at $1,102,000 annually. This is based on the National Park Service evaluation of the amount and value of the increased recreation use expected as a result of the construction of the projects. This evaluation will be continued by the National Park Service as new information and data are collected and plans for use are finalized.

Municipal and Industrial Water Benefits

Benefits from municipal and industrial water in present evaluations are confined to those that will result from the central Utah project and are estimated to average $1,438,000 annually. This estimate is based on the average annual equivalent cost of obtaining a comparable water supply from the most economical alternative single-purpose means of development.

The United States Bureau of Mines is highly optimistic in estimating the mineral possibilities of the region. Large undeveloped or underdeveloped reserves exist in the upper Colorado River basin area, according to the Bureau of Mines. "This area contributes a substantial part of these minerals (copper, lead, zinc, gold, silver, vanadium, and petroleum) and to a very great extent, the continued welfare of the Nation depends upon maintaining a healthy mineral industry within the upper Colorado River basin area."

A Mineral Storehouse

After declaring that the development and conservation of the mineral resources of the area are directly or indirectly affected by the development of water resources and power, the Bureau of Mines says that the total production of minerals from the upper Colorado River basin amounts to over $2,500,000,000 up to 1948, excluding uranium and vanadium. Coal and petroleum are the most important, coal representing over half the aggregate; the area is also the principal source of uranium and vanadium, and contains the Nation's principal reserves of molybdenum. Silver, gold, lead, and zinc are commercially important, and metals of minor interest include copper, manganese, bismuth, and antimony. Potash and magnesium occur in large, partly proven reserves, and phosphate rock is found in thick, medium-grade beds in Utah and Wyoming. The largest reserves of oil shale in the United States occur in northern Colorado and Utah and southern Wyoming within the basin.

Bituminous-Coal Reserves

The upper basin contains "enormous" reserves of coal, mostly bitumi-

nous and sub-bituminous grades, the reserves being much larger than those in any other section of comparable size in the world and amount to approximately one-third of all the coal deposits in the United States and one-sixth of those in the entire world. Bituminous coals from the upper basin are considered the highest quality bituminous coals on the Western market, in the opinion of the Mines Bureau, being low in ash and moisture, extremely low in sulfur, and highly volatile with a high heat value. Most coal mined in the Colorado area is bituminous but some good-grade anthracite is mined in Gunnison County.

Oil and gas have been discovered in 40 separate fields besides the oil shale deposit. Bituminous sandstone, another oil-bearing material of "great potential importance," says the Bureau of Mines, now is being used for road surfacing. The Vernal, Utah, deposit contains about 2 billion tons between 8 and 15% bitumen by weight, but can be recovered only by underground mining. The deposit at Sunnyside, Utah, also very large, averages 11% bitumen.

Gilsonite reserves, estimated at 25 million tons, occur mainly in the Uinta basin in Utah.

"This array of mineral fuels and carbonaceous materials is not approached by any region in any other part of the world," says the Mines Bureau.

Nonferrous Metals

Yet the area's resources do not stop with the fuels. The area has a very respectable production of gold, silver, lead, zinc, and copper among the nonferrous metals. The Climax molybdenum district, the largest in the world, has reserves estimated at 2 billion pounds of recoverable molybdenum plus by-products from the process, including tungsten, pyrite, tin, monazite, and topaz. The Plateau area of Colorado, Utah, Arizona, and New Mexico, the famous "Four Corners," is the principal source of the Nation's uranium and vanadium. Manganese occurs in the San Juan Mountains, in Eagle County, and at Leadville, just outside the basin. The Bureau of Mines describes the phosphate rock reserves as "enormous." Extensive deposits of carnallite have been found near Thompson, Utah, and associated beds of salt were 2,000 ft. thick. When other more economically situated deposits approach exhaustion, says the Mines Bureau, these deposits of phosphate rock and potash will doubtless become important sources of mineral fertilizer. Finally, adding zest to this mineral storehouse, pegmatite dikes in the granitic mountain masses in Colorado and New Mexico are the source of many uncommon nonmetallics, such as beryl, mica, lithium minerals, columbite-tantalite, feldspar, and numerous undifferentiated rare earth minerals.

The Upper Colorado River Storage Project and participating projects are a vast complex of public works, probably far greater in size and scope than most Easterners, and perhaps many in the West, realize. In scope and magnitude, it will rival any project the Nation has yet seen. By any evaluation that one can put upon it, considering the benefits to accrue from irrigation for municipal and agricultural uses, flood and sediment control, power generation, recreation, and industrial and mineral development, the gigantic dams and reservoirs would do much for the whole Nation, and probably justify the expenditure of the sums to be required for the network of dams and canals planned by the Bureau of Reclamation.

Note: This is the first of several articles THE EXPLOSIVES ENGINEER *will publish on the Upper Colorado River Storage Project. Subsequent articles will discuss the construction features of some of the large units such as the Glen Canyon and Flaming Gorge units.*

BLAST IN SPILLWAY: Blasting rock from the canyon rim in the left spillway area, Merritt-Chapman & Scott Corporation, contractors.

Dynamite Solves Tough Salvage Problem

The use of dynamite coupled with imagination spurs unusual salvage job after conventional method failed

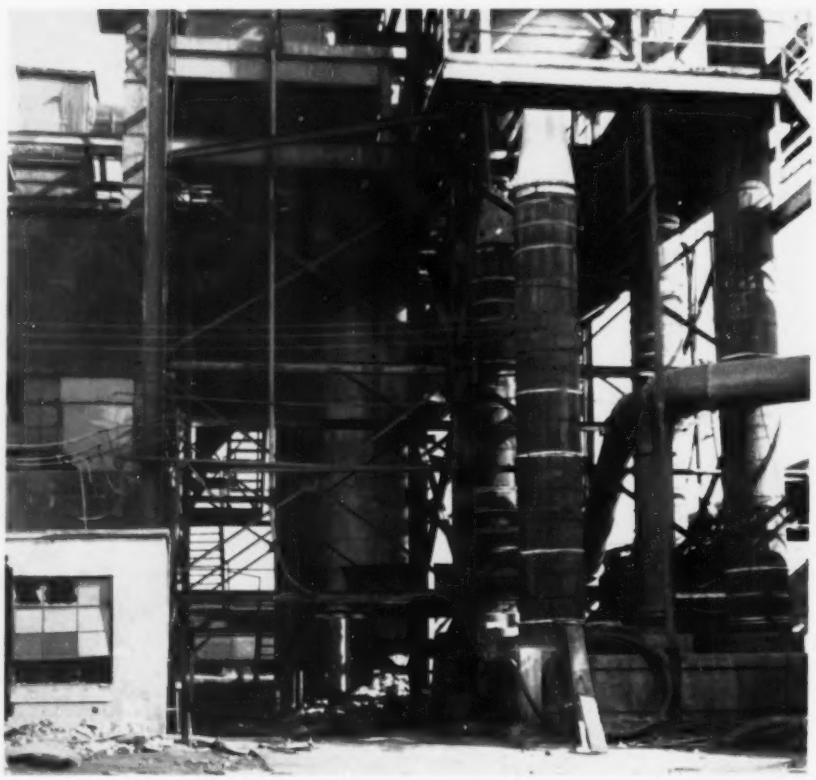
WILLIAM F. HALLSTEAD*

When the air-hammer team of an experienced dismantling firm finally decided it could not profitably salvage the lead lining of the Glidden Company's abandoned acid vats in south Baltimore, the challenging job was quickly accepted by Burnbrae, Inc., a Towson, Maryland, dynamiting contractor. After studying the problems that caused the previous contractor to withdraw, Burnbrae developed an entirely new technique to free the valuable lead sheet from its casing of brick and concrete. The main tool was dynamite plus know-how gained on varied jobs.

Unusual blasting applications are nothing new to Jack Loizeaux, Burnbrae's president, who has dynamited entire buildings in the center of busy Washington, D. C., and Pittsburgh, Pennsylvania. The idea of the Glidden job, though, was not heavy demolition. To the contrary, the blasting required a deft and light touch to cut loose the brick inner lining of the vats while the outside shell remained undisturbed.

The vats numbered four, each 50 ft.

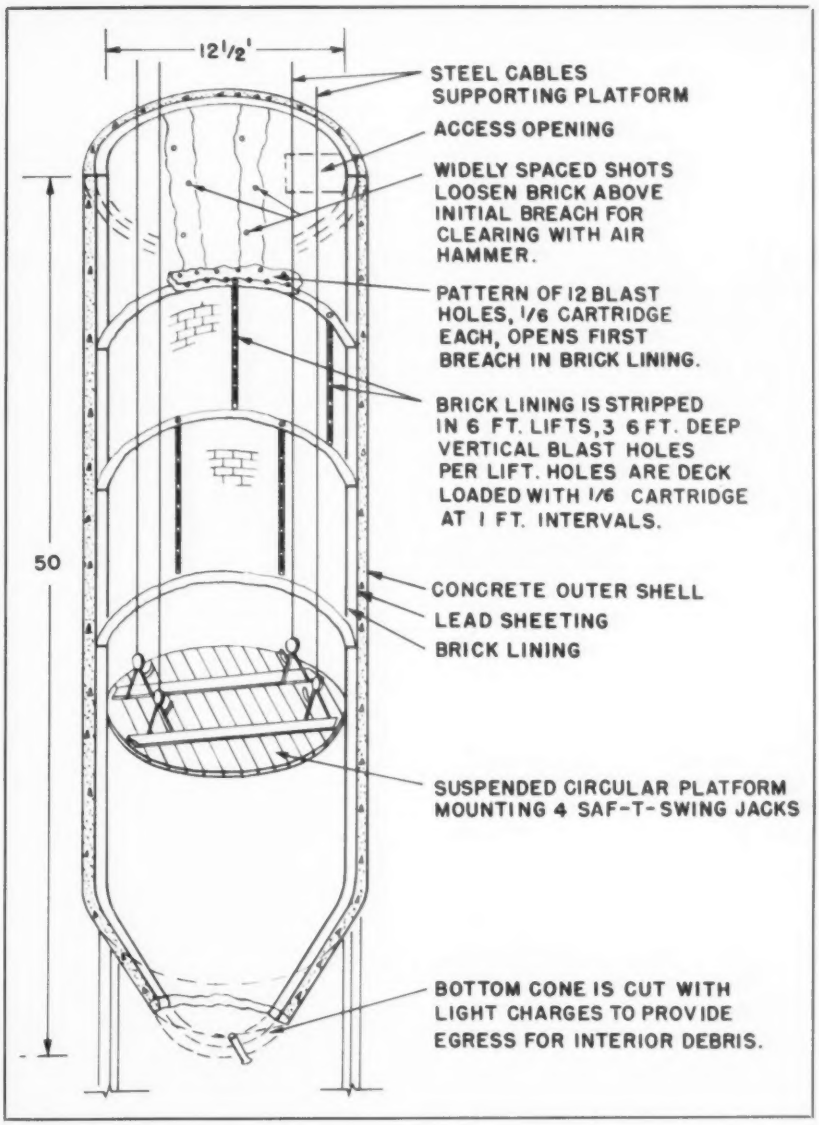
*517 Wyngate Road
Lutherville, Maryland



CLOSE QUARTERS: Salvaging the lead lining from Glidden's four acid vats required precision blasting to avoid damage to nearby plant units. One vat may be seen in the center of the photo. Two others are behind the vat shown, while the fourth is in back of the brick building.

high with an inside diameter of 12½ ft. They were supported in a steel framework, and access was through a 2-ft.-square hole in the top of each vat. At the bottom of each vat was a conical point containing a small outlet valve. The main shells were 12-in. reinforced concrete. The inner lining was 9-in. radial brick, and between the concrete and the brick was a ¾-in. sheathing of lead worth, at current prices, 10 to 10½¢ per pound. Burnbrae had purchased the job solely for what it might be able to make on the salvaging of the lead.

The first contractor's air-hammer crew had labored for two weeks to remove just one of the bottom cones to provide egress for the anticipated interior debris. For two more weeks, the crew worked in the first vat, standing on a swaying timber platform hung from ropes. In that time, it was able to chip loose only about 10 vertical feet of the tough brick around the vat's inner circumference. The exposed lead was burned free with a torch. This chipping and burning technique proved so slow and hazardous that the job was finally turned over to the Burnbrae organization.


12½'
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STEEL CABLES SUPPORTING PLATFORM
ACCESS OPENING
WIDELY SPACED SHOTS LOOSEN BRICK ABOVE INITIAL BREACH FOR CLEARING WITH AIR HAMMER.
PATTERN OF 12 BLAST HOLES, 1/6 CARTRIDGE EACH, OPENS FIRST BREACH IN BRICK LINING.
BRICK LINING IS STRIPPED IN 6 FT. LIFTS, 3 6 FT. DEEP VERTICAL BLAST HOLES PER LIFT. HOLES ARE DECK LOADED WITH 1/6 CARTRIDGE AT 1 FT. INTERVALS.
CONCRETE OUTER SHELL
LEAD SHEETING
BRICK LINING
SUSPENDED CIRCULAR PLATFORM MOUNTING 4 SAF-T-SWING JACKS
BOTTOM CONE IS CUT WITH LIGHT CHARGES TO PROVIDE EGRESS FOR INTERIOR DEBRIS.

WORKING PLANS: This diagram of an acid vat shows the various steps taken by the Burnbrae engineers to solve the tough job of salvaging the valuable lead lining.

Method of Operation

Using light charges—¼th cartridge of 40% gelatin dynamite per hole—the demolition firm cut off the three remaining bottom cones in one day. The rope-slung scaffold was replaced with a close-fitting circular platform mounting four Saf-T-Swing jacks. From the jacks, steel cables ran through the vat roof to the steel main structure. This jacked platform enabled the drilling and blasting team to raise and lower its position from the vat interior with minimum lost time.

The liner bricks were wedge-shaped and fitted together with a tight precision that had defeated the first demolition crew. Burnbrae opened up the brick in each vat with an initial pattern of 10 to 12 light charges—again, ¼th cartridge of 40% gelatin dynamite per hole—placed in staggered rows about a foot apart. Blast holes, made with carbide insert bits in Cleveland drills powered by a Davey compressor, were 1½ in. in diameter and 9 in. deep. This first spread was located about 7 ft. from the top of the vat. It and all subsequent charges were fired with instantaneous caps.

The first loading opened a breach in the lining about 3 by 9 ft. Several more blasts were fired individually as required between the breach and the vat roof, and the loosened bricks were cleared by hand and with air hammers down to the level of the first charges.

With a 7-ft.-deep ring of brick cleared away, the drilling was now done vertically—6 ft. down into the brick lining, parallel to the lead sheet and as close to it as possible. Three of these 1½-in.-diameter vertical holes were drilled for each firing. Each hole was deck-loaded with ¼th cartridge of 40% gelatin dynamite primed with an instantaneous cap at 1-ft. tamped intervals. Prior to each firing, the platform was jacked above the blast level. Debris simply dropped through the vat and out the cone aperture, and the platform was then lowered for air-hammer clearing of the ruptured brick face. Lighting was provided by an extension rigged to the still-serviceable power line into the area.

Using this system of three deck-loaded 6-ft.-deep holes per firing,

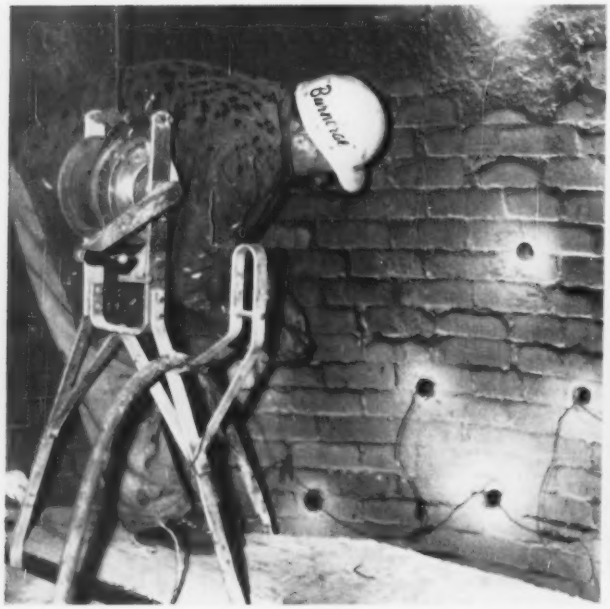
Burnbrae was able to knock out the brick lining in fast 6-ft. lifts, using 25 lb. of explosives per vat. The job was speeded up even more when the blasting firm decided to cut the lead loose with macadam cutters. This proved to be at least four times faster and infinitely safer than the use of torches.

In 3½ weeks—less than the total time the first contractor had spent on just half of one vat—the blasting firm stripped about 40 tons of lead, more than $8,000 worth, from the four vats, leaving the reinforced concrete shells intact as required in the contract.

This job had defeated the use of conventional dismantling methods, but Burnbrae's experienced staff was able to make it a success through the imaginative, well-planned, and well-executed use of dynamite.

BOTTOM CONE: The bottom cone of each vat was removed by using small charges of 40% gelatin dynamite. The opening at the bottom of the vat facilitated the removal of the interior debris.

INSIDE THE VAT: Standing on a suspended platform, the drillers prepared holes for the light dynamite charges designed to remove only the brick lining, behind which was the lead lining.



HOOKING UP: The initial breach was made in each vat with a pattern of 10 to 12 charges of gelatin dynamite placed in staggered rows about a foot apart. The resulting breach was 3 by 9 ft.

SALVAGING THE LEAD: After the brick lining was removed, macadam cutters were used to strip off the lead lining. A total of approximately 40 tons of lead was salvaged from the four vats.

Multiple Short-Period Delay Blasting In Underground Bituminous-Coal Mines

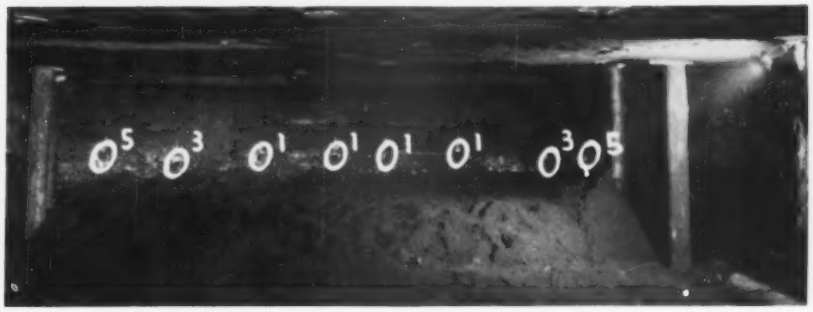
Tests prove the feasibility of using Short-Period Delays for better breakage, improved safety, and faster mining cycle

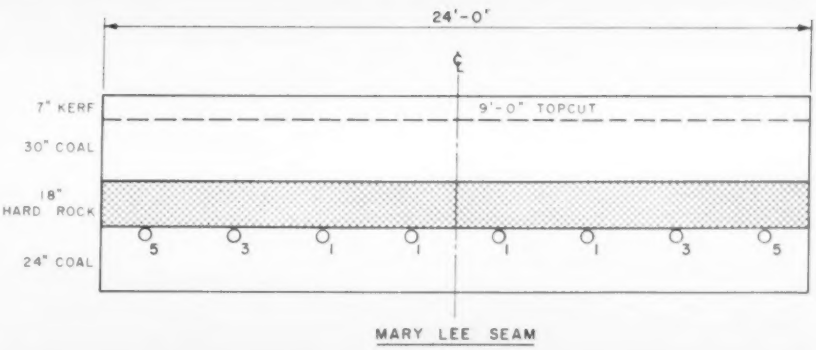
DENNIS V. PLAN*

THE notable improvements in the results obtained in quarry blasts since the introduction of short-period delay blasting some years ago have led to the adoption of this technique by other segments of the explosives-consuming industries. Just a little more than a decade since their initial use in quarrying, Short-Period Delays are being used successfully in many forms of underground mining, open-pit mines, coal strippings, shafts, tunnels, and various types of construction work. The latest type of mining to find short-period delay firing advantageous is underground bituminous-coal mining.

For many years, explosives designed for coal mining and the various methods of detonating them have been subjected to many stringent state and Federal regulations, and rightly so. The accepted and approved practice in firing explosives in underground bituminous mines has been to load and fire one hole at a time, testing for gas after each hole fires. Then, if conditions are satisfactory, the shot-firer loads and connects the next hole and retires to a place of safety to detonate the charge. This is a tedious and time-consuming procedure that often results in the miner's taking short cuts which sometime lead to unsafe practices.

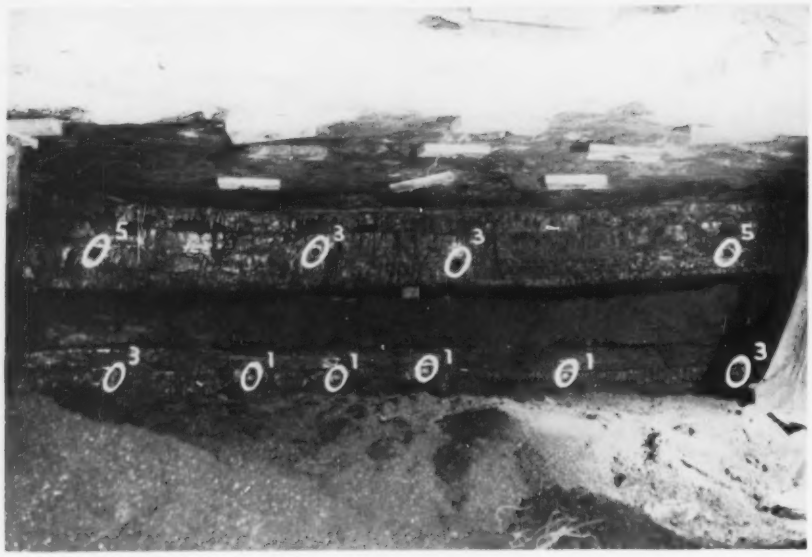
Regular delays with their longer firing intervals were not considered satisfactory for use in underground bituminous mines because there was the hazard, although rather remote, of gas

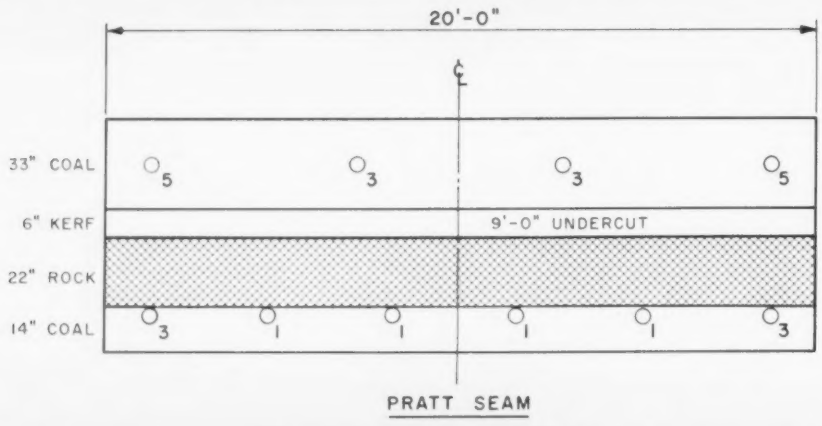




TOPCUT: A variation of a topcut with a single row of holes drilled immediately below the rock band using No. 1 Short-Period Delays in the center holes, period 3 in the next holes, and No. 5 in the rib holes. This is the Mary Lee Seam in Jefferson County, Alabama.

*Hercules Powder Company
Birmingham, Alabama





CENTERCUT: Elevation view of a section of the Pratt Seam in Jefferson County, Alabama. Satisfactory results are obtained by Short-Period Delays in mining this 69-in. seam which has a 22-in. rock band separating the coal. In this section, the coal below the rock band was fired first, using periods 1 and 3 Short-Period Delays. A centercut immediately above the rock relieved the top layer which was blasted using 3 and 5 Short-Period Delays.

pockets being exposed before all holes had fired, which subsequently may become ignited by the detonation of succeeding holes.

Experimental Work Begins

Being aware of the economies obtained by the use of multiple short-period blasting in other forms of mining, a group of Alabama coal mine operators decided to investigate the method to determine its feasibility in underground bituminous mining. After reviewing the results of some experimental work using Short-Period Delays in other states, these operators, in conjunction with other interested concerns, obtained special permission from the State Bureau of Mines to experiment with Short-Periods under controlled conditions, with safety being the main consideration.

When the results of these experiments, which covered a period of several years, were tabulated it was found that the use of short-period delay firing produced coal with less fines and with a faster mining cycle. Other important advantages were the improved safety conditions, a reduction in the number of holes required, and the consequent reduction in explosives consumption.

With their facts assembled, the mine operators initiated a movement to gain state approval for multiple-hole blasting in which electric blasting caps with millisecond delay intervals would be used. Through the efforts of an active committee of these men, a bill authorizing this type of blasting was passed by both Houses and signed into law on August 14, 1957. With the signing of the bill, it was the opinion of many men in the industry that a significant step had been taken toward improving safety at the face through this more efficient and more productive blasting method. Results observed in the succeeding months revealed several benefits to safety, which directly resulted from blasting coal in this manner. These benefits are tabulated below.

1. Less exposure of shot-firer to unprotected roof and to smoke since the shot-firer is not required to enter the working place several times, as in single-shot firing.
2. Less smoke produced because of

more efficient use of explosives.

3. Less roof damage.
4. Ribs and face are trimmed better.
5. Less disruption of ventilation.

This blasting method also resulted in the following economical advantages:

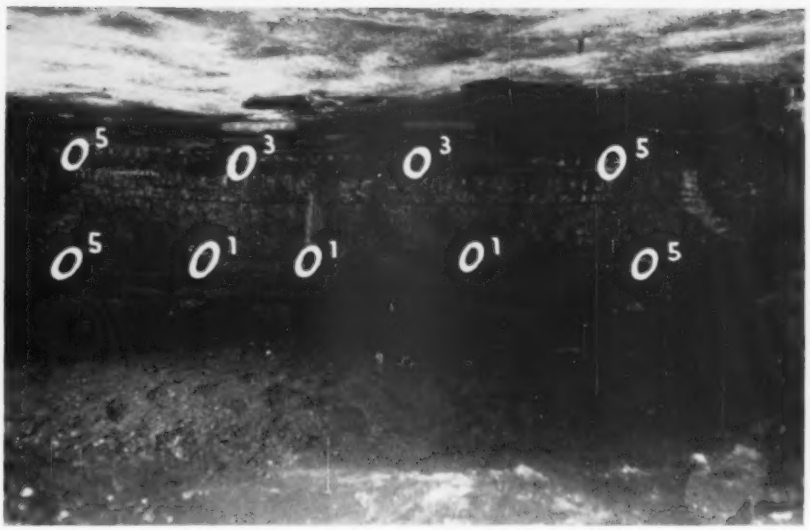
a. Improved and more uniform fragmentation—less fines.
b. Improved loadability of coal.
c. Entire mining cycle accelerated—shot-firer can prepare more places and loading machine can load out a fall of coal in less time. Roof and ribs require less attention since they are not affected as much from the blasts.
d. Uniform fragmentation usually results in reduced cleaning costs.
e. In most instances, fewer holes are required, consequently drilling and explosives costs per ton are decreased.

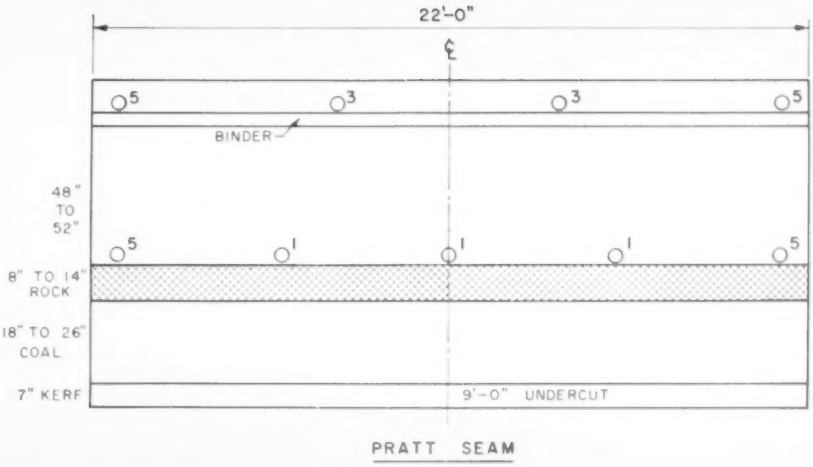
Explosives savings have ranged from 10 to 20% per ton of coal.

Results are Excellent

Most of the mines that have adopted Short-Period Delays are also using permissibles in King-Size cartridges with excellent results. These long-length cartridges, in diameters of 1 in. to 2 in. and in lengths of 16, 20, and 24 in., perform more efficiently than a column of short-length cartridges; consequently, less smoke is produced in the blast and men can enter the working places more quickly. With such increased efficiency, powder consumption can be reduced and holes can be loaded in less time. The long-length cartridges also minimize the chances of bug dust getting between cartridges, which often causes cutoffs, since there will be little or no break in the powder column. In many cases, a fixed charge can be established for a mine and King-Size cartridges will effect better control over powder consumption.

With the recent U. S. Bureau of Mines approval of millisecond delay blasting in bituminous-coal mines, it is expected that many underground operations will want to learn how their production and safety can be improved through the use of Short-Period Delays. The accompanying sketches illustrate how S.P. Delays are used in typical cuts.





PRATT SEAM

UNDERCUT: Another method of using Short-Period Delays in the Pratt Seam where the height ranges from 74 to 92 in. with a rock band about 22 in. from the floor and a minor slate stratum about 6 in. from the roof. The Short-Period Delays 1 and 5 loaded in holes above the rock moved the lower part of the face first. The upper section was then blasted using Short-Period Delays 3 and 5.

NEWS NOTES

FIRE EXTINGUISHER GUIDE

A six-page folder titled "A Guide To Fire Extinguishers" has been issued by Ansul Chemical Company, Marinette, Wisconsin.

The folder contains a table which compares characteristics of various types of fire extinguishers. A bar graph on the last page shows the comparative effectiveness of extinguishing agents according to Underwriters' Laboratories' ratings. Cutaway drawings of an Ansul dry chemical extinguisher and an Ansul stored pressure water extinguisher are printed inside the folder.

For a free copy, write to Fire Equipment Division, Ansul Chemical Company, Marinette, Wisconsin.

CRAB TRACTOR BULLETIN

Napco Industries, Inc., manufacturers of the Napco Crab Tractor, recently announced that new literature is available describing the company's four-wheel drive, four-wheel steer tractor. The two-color brochure includes action photographs of the Napco Crab Tractor at work.

Important features of the four-wheel drive, four-wheel steer tractor, such as the torque converter, steering selector, hydraulic reversing clutch, power steering, planetary axles, etc., are also illustrated.

This bulletin can be obtained by writing to Construction Equipment Division, Napco Industries, Inc., Seventh Street-North Lyndale, Minneapolis 11, Minnesota.

RAIN-TIGHT, EXPLOSION-PROOF SWITCH

A new enclosed switch listed by Underwriters' Laboratories as being rain-tight as well as explosion-proof has been introduced by Micro Switch, Freeport, Illinois, a division of Minneapolis-Honeywell Regulator Company.

Catalog listing 2CX3 has aluminum die-cast housing and dome cover. It is designed for use on fuel-handling equipment, rocket- and missile-launching devices, industrial valve-control systems, and other hazardous outdoor installations.

The manufacturer states that Underwriters' Laboratories lists the switch as being suitable for use in Class I (vapor-air mixtures)—Groups C and D; Class II (dust-air mixtures)—Groups E, F, and G.

Electrical capacity is UL listed at 20 amp., 125, 250, or 460 vac. The 2CX3 also is capable of undergoing a 100-hour salt-fog test without injury to the actuating mechanism or precision switching units, the manufacturer also claims.

Data Sheet 156, which may be obtained by writing Micro Switch in Freeport, has photographs, dimension drawing, characteristics, electrical data, and mounting information.

PERFORATED METAL SCREENS

How to specify perforated metal for coal and aggregate screens is described in 12 steps in a new brochure available from Cross Perforated Metals, National-Standard Company. The brochure describes Cross Hexcreen, Conidure pierced sheets, and Rima wedge-shaped wire screens.

Copies of this new brochure can be obtained free upon request by writing to Cross Perforated Metals Plant, National-Standard Company, Carbondale, Pennsylvania.

SELF-STICKING SAFETY SIGNS

Over 400 stock self-sticking accident-prevention signs are described in a new eight-page illustrated catalog offered by W. H. Brady Company of Milwaukee.

The manufacturer claims that industrial safety programs can incorporate self-sticking signs in a low-cost marking program to reduce accidents. The wide range of stock signs available cover most safety or plant housekeeping situations. Twenty-six groups of signs—covering electrical hazards, fire hazards, first aid, industrial housekeeping, machinery, personnel, traffic, and general industrial signs—are included in the new catalog.

For testing sample of Brady self-sticking safety signs and a copy of the new, full-color, illustrated catalog, write W. H. Brady Company, 727 West Glendale Avenue, Milwaukee 9, Wisconsin.

REPORTS ON COAL STUDIES

Two reports on coal research by the Bureau of Mines were released recently by the Department of the Interior.

The publication concerning the West Virginia coal is known as Report of Investigations 5453, "Carbonization Properties and Petrographic Composition of Hernshaw Coal from Boone County, West Virginia." It was written by B. C. Parks, H. J. O'Donnell, G. W. Birge, and F. H. Gibson, all assigned to the Pittsburgh, Pennsylvania, station of the Bureau.

The second publication, Report of Investigations 5475, "Preparation Characteristics of Coal from Washington County, Pennsylvania," was written by T. E. Gray and E. R. Palowitch, also of the Pittsburgh station.

Copies of the reports may be obtained from the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Avenue, Pittsburgh, Pennsylvania. The publications should be identified by number and title.

DRILLING INFORMATION SHEET

A new product-information sheet describing recent developments in Truco portable and mobile diamond drilling equipment has been prepared by Masonry Drilling Division, Wheel Trueing Tool Company, 3400-62 West Davison, Detroit 38, Michigan.

New products illustrated and described are the Truco Mighty Model G, heavy-duty, portable diamond drilling machine for drilling holes up to 20 in. O.D. and the same unit converted for mounting on a truck or low-bed trailer for test-coring and other diamond drilling on highways, airports, parking lots, and construction jobs beyond the power lines. Also shown are smaller Truco drilling machines, truck-mounted, for drilling wherever a truck can be driven. All units are available with electric, air, or gasoline power.

TRUCK CRANE BULLETIN

A new 12-page bulletin just issued by Schield Bantam Company describes and illustrates the Model T-350, including the complete line of Bantam-built crane carriers available for mounting, and the Bantam-built front-end attachments. Included are sections devoted to standard and optional features found on the T-350.

Free copies of the new bulletin are available from Schield Bantam Company, Waverly, Iowa.

TRACTOR SHOVEL SPECIFICATIONS

A specification bulletin which, according to the manufacturer, explains the features that enable the new Model 304 Trojan tractor shovel to deliver maximum production for the user, combined with fast, economical operation, has just been released by the Trojan Division of The Yale & Towne Manufacturing Company.

Of interest to bulk materials producers and contractors is the fact that the new Trojan 304 has three interchangeable buckets which give the machine a carrying capacity of from 2 to 4 yd. The two-page color bulletin lists the standard and optional equipment for this newest Trojan tractor shovel and is available from The Yale & Towne Manufacturing Company, Trojan Division, Batavia, New York.

INGERSOLL-RAND DEEP-HOLE DRILL

Ingersoll-Rand has introduced a new, heavy-duty, deep-hole hammer drill designated Model D40 that utilizes conventional (left-hand) rotation as well as reverse (right-hand) rotation. According to the manufacturer, a selector incorporated into the backhead permits instant changing of the rotation so that the power of the drill can be put to work for coupling or uncoupling steels, a very useful feature for efficient deep-hole work.

The D40 has a 4-in. bore and handles bits up to 3 in. in diameter. It is designed to be used with the Ingersoll-Rand FM4 drill guide, which means it can be applied to self-propelled mountings such as the Ingersoll-Rand CRAWL-IR; and to wagon drills, hydra-booms, and pipeline mountings that can utilize this drill guide.

Other extra features claimed by the manufacturer of the D40 include 6-pawl rotation and a closed fronthead. The locked-in 1½-in. Leyner shankpiece is designed to permit the use of heavier 1¼-in. hexagon Type 60 carburized steel and I-R Type 60 Carset bits. The drill also has a ½-in. straight-through air-and-water tube that provides exceptional hole cleaning and resultant faster penetration.

Ingersoll-Rand Company, 11 Broadway, New York 4, New York, will send more details upon request.

TONG TEST AMMETER CATALOG

A new eight-page catalog on its complete line of Tong Test AC-DC Ammeters has just been released by Columbia Electric Mfg. Co., 4519 Hamilton Avenue, Cleveland 14, Ohio. The bulletin illustrates eight types of instruments and gives detailed information on the selection and use of Tong Test Ammeters. The free bulletin, available from the manufacturer, includes prices and shipping weights.

HOSE-COUPLING BULLETIN

A new eight-page bulletin in color has just been announced by Hose Accessories Company. The LE-HI condensed catalog is illustrated and contains essential information on the wide variety of LE-HI hose couplings and fittings. For a copy of the bulletin, write to Hose Accessories, 2704 North 17th Street, Philadelphia 32, Pennsylvania.

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Future Reference

The six issues of The Explosives Engineer published in 1958 are available, bound attractively in cloth. These will be sent to post-office addresses in the United States and Canada for $6.50 each, or for $7.50 to other countries (limited).

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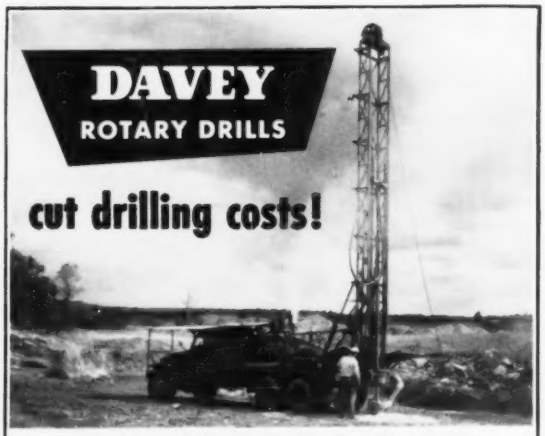

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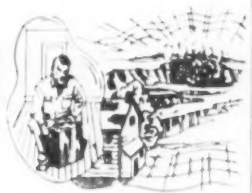

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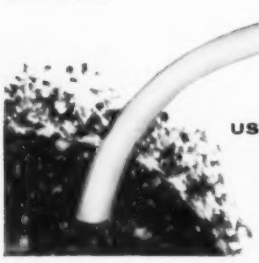

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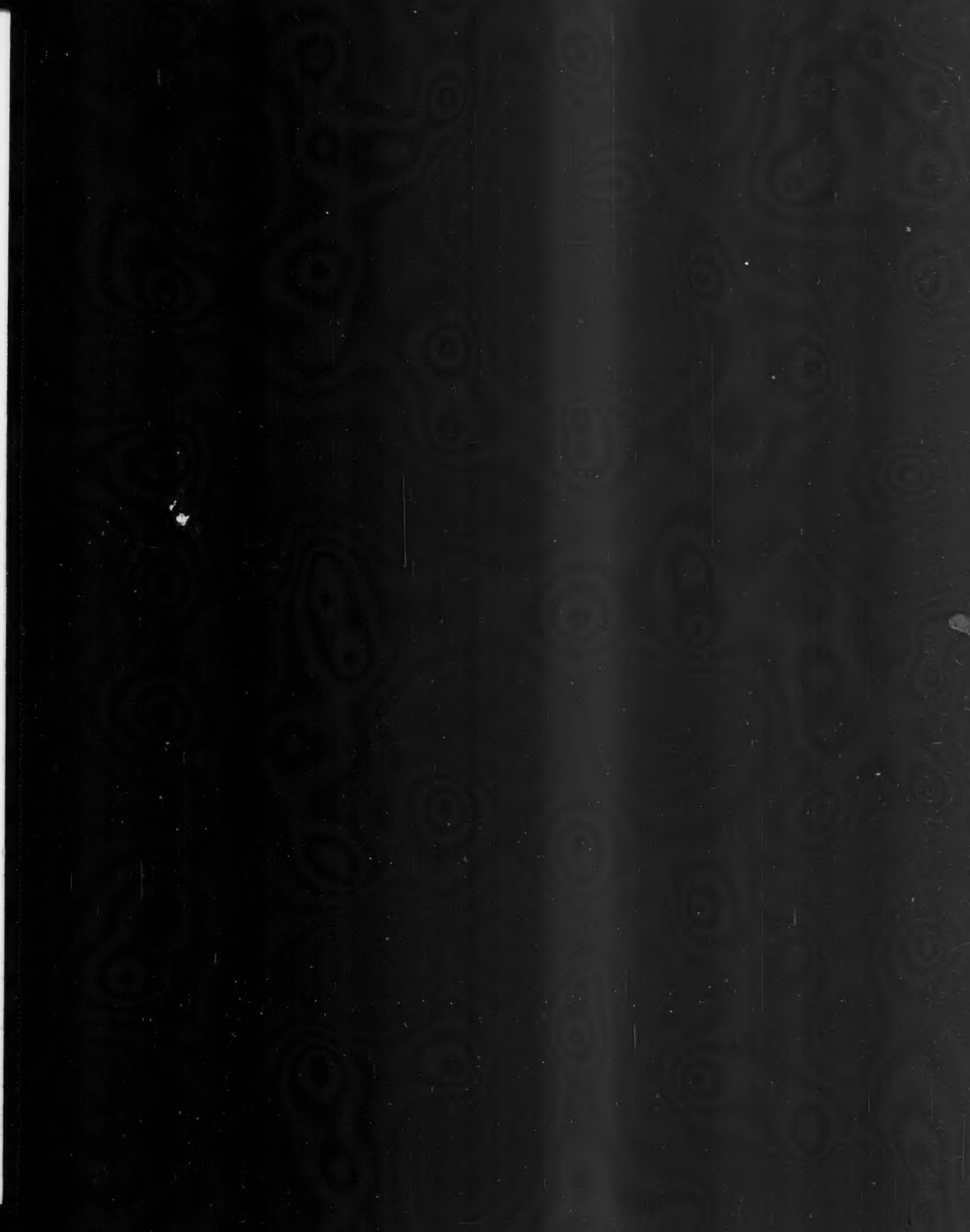
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